

Pulse-Height Tallies with Variance Reduction Techniques

MCNPX allows the use of most variance reduction techniques (VRTs) with pulse-height tallies (PHTs). The following input file runs 132 times faster than the same analog pulse-height tally problem (as measured by the average speedup per energy bin.) The results are statistically the same:

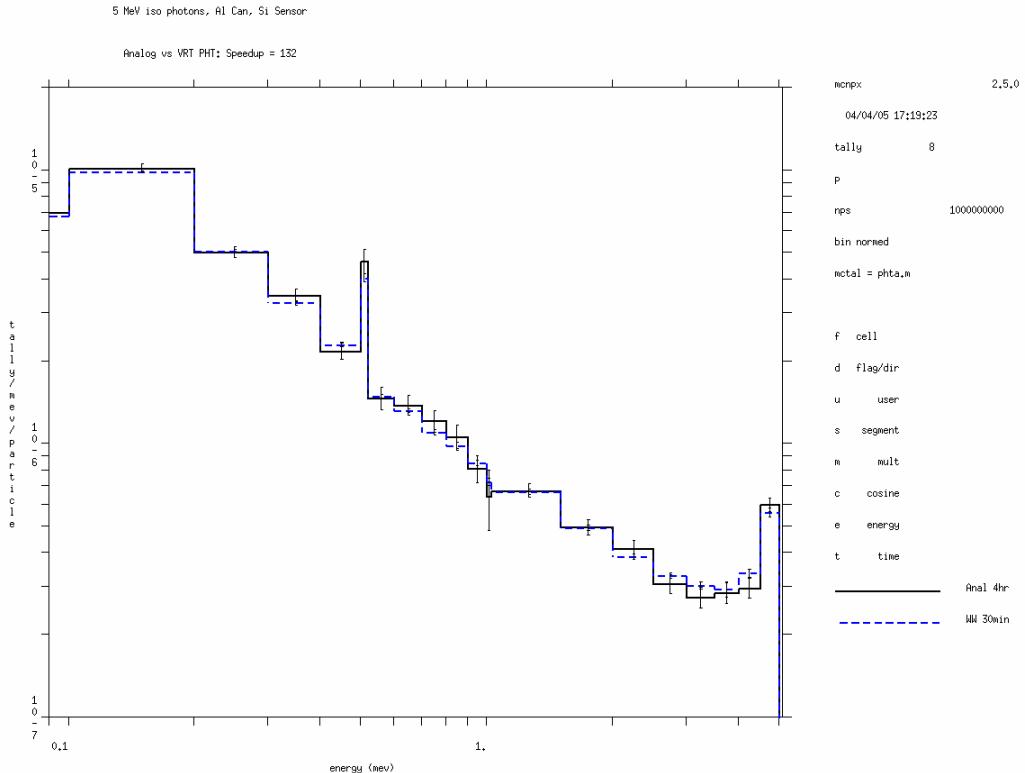


Figure 1. Analog results vs VRT results for PHT problem. The answers are statistically the same but using VRTs makes the calculation 132 times faster.

These results are easy to reproduce with the following files. The analog problem ran 1 billion histories in 6 hours; the VRT problem had relative errors much smaller in 30 minutes. Note that only mesh-based weight windows were used. Other variance reduction techniques and further optimization would likely improve the VRT results even further.

Note that DXTRAN does not work with PHTs and also note that VRTs having lots of Russian roulette can actually do more harm than good. But if VRTs are selected carefully, speedups of 1 – 3 orders of magnitude are possible.

To reproduce these results, run with:

```
mcnp x inp=phtinp wwinp=phtww name=jpht
```

Plot with:

```
rmc jpht.m tal 8 loglog free e xlim .09 5.1 ylim 1e-7 2e-5
```

The input file is “phtinp”:

```
Pulse-Height Tally with Variance Reduction
1 21 -2.7   -11 12
2 22 -10.0   -12
3 0         11

11 RCC 0 0 0 0 120 0 50
12 SPH 0 100 0 5

imp:p 1 1 0
wwp:p 3 2 3 0 -1
mode p
phys:p j 1
cut:p 2j 0 0
m21    13027 1      $ aluminum
m22    32000 1      $ germanium
print -161 -162
c
sdef erg 5 pos 0 .01 0
nps 100000
prdm p 2j 1
f8:p 2
e8 0 1e-5 .001 .1 3i .5 .52 .6 3i 1 1.025 1.5 7i 5.5
```

The weight-window mesh file is “phtww”:

1	1	2	16	11/04/04 11:06:23	
0	1				
4.0000	24.000	1.0000	0.0000	-0.10000	0.0000
2.0000	1.0000	1.0000	0.0000	120.10	0.0000
50.100	-0.10000	0.0000	2.0000		
0.0000	1.0000	5.0000	1.0000	3.0000	50.100
1.0000					
0.0000	24.000	120.20	1.0000		
0.0000	1.0000	1.0000	1.0000		
100.00					
0.25000	31.960	0.0000	0.0000	0.39774E-01	2.0399
0.0000	0.0000	0.14644E-01	0.43242	0.0000	0.0000
0.69914E-02	0.15145	19.419	0.0000	0.38151E-02	0.65389E-01
7.7824	0.0000	0.22097E-02	0.30771E-01	2.2066	0.0000
0.13575E-02	0.15815E-01	0.85017	26.272	0.84294E-03	0.86767E-02
0.33538	12.598	0.53028E-03	0.48644E-02	0.14718	21.772
0.34060E-03	0.28866E-02	0.73424E-01	3.8576	0.21596E-03	0.17100E-02
0.39537E-01	2.8427	0.13808E-03	0.10339E-02	0.21287E-01	1.0879
0.89284E-04	0.63519E-03	0.12242E-01	0.46913	0.56658E-04	0.39476E-03
0.73910E-02	0.21557	0.35300E-04	0.24943E-03	0.51712E-02	0.14229
0.21925E-04	0.15928E-03	0.34740E-02	0.12789	0.13301E-04	0.10354E-03
0.26474E-02	0.91663E-01	0.76467E-05	0.68007E-04	0.21160E-02	0.90011E-01
0.39516E-05	0.47058E-04	0.19922E-02	0.80536E-01	0.18588E-05	0.37522E-04
0.25973E-02	0.24821	0.27130E-05	0.56290E-04	0.33859E-02	0.0000
0.18192E-04	0.18686E-03	0.52626E-02	0.36615	0.15235E-03	0.67051E-03
0.98077E-02	0.72445	0.70731E-03	0.49052E-02	0.15649	0.0000